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Mechatronics for elevator installers and drive technicians, part 11

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A primer for upgrading elevators

Regardless of changes which will have to be made during elevator modernization projects as a matter of simple necessity to satisfy applicable EN standards, errors typically found in conjunction with elevator upgrades are to be considered here from the purely technical viewpoint.

Before you assemble new materials for the existing system, you should make an assessment of the existing elevator and compile with a list of deficiencies. The decision as to whether to simply repair a particular component or replace it completely will have to be weighed primarily in light of the costs involved. The owner's willingness to shoulder the expense of modernization will require a thorough analysis of the system's momentary condition and, if at all possible, presenting several alternate proposals for retrofitting.

1. The existing motor:

- a) Asynchronous motor with silumin rotor (usually one- or two-speed or with pole switching or comprising two motors on a common shaft)
- b) DC motor (as a rule with a Ward- Leonard converter and sometimes in a gearless design)
- c) Pump motor (hydraulic with or without „soft-start“ circuitry)

2. The existing brakes:

- a) DC braking solenoid (single- or dual- circuit, actuating brake jaws)
- b) 3-phase brakes (single- circuit solenoid system, usually linked directly to the motor controls)

3. The existing gearing:

- a) Worm gear (usually with an elastic coupling, less frequently flanged directly to the system)
- b) No gearing (gearless DC)

4. The existing controls:


- a) Relay control (in some cases with unusual voltages of from 48 V to 110 V)
- b) Old electronic controls (in some cases still using electronic tubes and germanium diode technology)

5. Other mechanical components:

- a) Door system (in some cases manually actuated hoistway doors, with or without doors inside the car)
- b) Safeties, regulators, control panels, displays, emergency communication system etc. (We will forego discussing these any further at this point, since they will as a rule be replaced in any case.)

The elevator's carrying capacity and operating speed are also very important in making decisions. In the present chapter we want to consider modernization purely from the electrical technology viewpoint. In our example older traction lifts (before 1980) are to be modernized. We will also have to take a look at the condition of the existing power supply system: power line from the sub- panel, potential equalization and grounding, and the type of conductor system.

You should first determine whether the existing power feed cable can be left in service. If the carrying capacity and speed are not to be increased, then the existing conductor cross- sections – provided that the cables are up to code – would be sufficient, since the modern drive will draw less power. It is important that the elevator be supplied directly from the sub- panel and that no other using units be served by this circuit. This is important since unexpected network problems could otherwise appear when changing over to frequency converter technology. Be absolutely sure that the four- conductor system be subdivided from PE to N + PE only right inside the switchgear cabinet (and not at an intermediate distribution panel or upline fuses or circuit breakers which may be

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present) as otherwise problems in the power supply network will be inevitable. When using 5- conductor systems, check to ensure that there is no unbalanced load at the star point (neutral point) and in doubtful cases do not use N (use a control voltage transformer which Steps down from 400 V to 230 V).

Now take a close look at the drives. Determine whether a rotation speed transducer can be installed. From the regulation technology viewpoint, even fitting a simple incremental transducer is better than having nothing at all to register momentary operating speeds. If the mechanical mounting work for a rotation speed feedback device would be excessive, then it is possible to operate without a transducer. As a rule, however, this will work satisfactorily only if travel speed of about 0.5 m/s is not exceeded (or for a lift with less than 320 kg carrying capacity this may be up to a maximum of 0.8 m/s). The reason for this is that the old „silumin“ motors exhibit rotor time constants which are highly dependent upon temperature and load (a high degree of slip) and thus under certain circumstances considerable discrepancies, depending on the travel direction, will appear in regard to the approach path and leveling if a non-feedback system is employed. The cost argument cannot be used here since commissioning an „U/f-controlled“ system – i.e. one without feedback – usually consumes far more time than is the case for a „field- oriented,“ closed- loop regulation system.

As regards the gearing we are assuming at the outset that the worm, bearings and coupling are still in good condition. The question as to whether flywheels need to be removed can be answered as follows: in the case of „U/f- controlled“ systems they should be removed if at all possible. In „field- oriented regulation“ systems they will be removed only if they are located opposite the rotation transducer (see the first „mechatronics“ report, Lift- Report 1/0); otherwise they may remain in place. The flywheel masses can cause problems in those types of machinery where the masses are located between the motor and the gearing (P amplification may be insufficient). Important: every change in the gearing, motor, clutch and flywheel or handwheel will make it necessary to re- balancing the rotating system. Do not underestimate this effect since otherwise serious vibration could occur; this will not only severely degrade ride comfort but will also damage the bearings and worm shaft.

As regards the motor we are assuming that there is no visible damage to the windings (suspicious discoloration at the winding or rotor). Please note that when dealing with two- speed models only the „faster“ speed will be used after conversion (and if you can no longer read the data plate, then the „fast“ speed is always the one with the lower impedance – and thus the heavier winding wire). Please also note that not all frequency converter brands are capable of running old winding packages, which may be fairly delicate (often still rated as insulation class B). dU/dt filters will always be required between the motor and the power output (pure line filters will in no case be sufficient). If the system has not been run for an extended period of time, then the winding may have absorbed some moisture. In this case it is recommended that the winding be dried before connecting a frequency converter to the motor. To do so remove the ropes, connect the motor directly to the power supply and let it run at idle for a certain period of time (switch off the fan motor).

The motor should be replaced if there is excessive axial play, if mounting the transducer appears to be unavoidable due to increased carrying capacity and higher speed, or if there are any reservations at all in regard to the safety of the motor. The DC motor should be replaced if its armature voltage is less than 400 V (and this is unfortunately usually the case). In gearless DC systems it may under certain circumstances be worthwhile to leave the motor in service if high armature voltage is present. Here direct operation using a so- called GSV unit (a DC power supply based on a modern IGBT – insulated gate bipolar transistor, meaning that the Ward- Leonard transformer is eliminated and no thyristors are used) is an alternate to retrofitting with modern synchronous or asynchronous gearless concepts. When modernizing complete banks of elevators it is necessary to remember that the change in reactive connected power (wattless current) will have an effect on a compensation system which may be in place. (The network voltage in the building may under certain circumstances rise since the high

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wattless current in the previous pole- switching systems is suddenly no longer present.) The „cosine- phi“ value will have to be set anew if over compensation is detected. If you must (or wish to) upgrade the system entirely in regard to the motor and gearing, then with the drive machinery located at the foot of the hoistway you may select as desired between a normal geared unit and a gearless concept. Where the drive machinery is at the head of the shaft, using gearless technology is not advisable where the building ´s electrical system is quite old an reworking the subdistribution panel is not also being considered as part of the project (PE dissipation currents can have a negative effect in mixed 4- and 5- conductor systems). When modernizing hydraulic lifts the pump should be run under frequency control.

As regards reusing existing relay controls, you should always convince the owner to replace them with modern, brand- name controls since operational reliability in conjunction with frequency regulation is often not satisfactory. (Problematic here are the multitudof differing minor voltages cross- linkages of potentials). If „electronic“ elevator controls are indeed in place, but if these still utilize tube or germanium technology, then they should always be changed out since spare parts for the systems are virtually impossible to find.

There are several important items which will have to be observed when re- connecting the controls to modern closed- loop control technology. In certain old systems the brake solenoid (and this is almost always the case in the old 3- phase, solenoid brakes) is connected directly to the motor winding. This means that the motor and the brake will be controlled simultaneously and directly by the travel relays. Connections such as this are not possible when using frequency converters. During the upgrade the motor and brakes will have to be set up so that they can be switched independent one of the other. The error most frequently made when installing a frequency converter is that the travel relays open at the exact same moment that the brakes are engaged. This makes it impossible to stop the car electrically, which in turn will cause problems in leveling and will damage the travel relays over the long term. Consequently the most important measure is to ensure that, when starting, the travel relays are closed before the brakes are released and that the travel relay contacts open only after the brakes have actually been mechanically engaged. Only in this way can one guarantee that the travel relays will always be free of load when switched (and this is a service life issue). In the same way, the brake jaws may engage with the brake drum or brake disk only after the systems has been brought to a standstill by electrical means (brake lining service life). You ca readily observe this while the system is in service. When the elevator starts you will first hear the click of the travel relays and then that of the braking relay; once the brakes have been released mechanically the shaft remains still briefly before it gradually begins to rotate. Conversely you see how the motor Stopps in the leveling range, remaining briefly at a standstill before you hear the brakes engage and then the release of the travel relays. If all these conditions are satisfied then there will be no noticeable jerk when starting or stopping; neither will there be arcing at the travel relay or friction- Induced wear at the brake linings. One final point should be mentioned. The old brake coils will usually not be fitted with radio interference supression circuitry (varistors); this is also true for the coils at the old travel and auxiliary relays. These circuits will, naturally, have to be retrofitted to preclude unexpected responses when operating with today ´s modern elevator control systems.